Concepts for Science and Applications Missions in the Post-2002 Era

Request For Information

This is a Request for Information (RFI) by the National Aeronautics and Space Administration (NASA) about concepts for science and applications missions in the post-2002 time frame. With this RFI, NASA's Earth Science Enterprise (ESE) is beginning implementation of the new paradigm for mission planning for the post-2002 missions. The objectives are to further develop the scientific measurement strategy implemented in the first series of Earth Observing System (EOS) satellite missions and to take advantage of today's advanced technologies and launch opportunities. This will allow NASA to pursue further scientific advances and to demonstrate valuable applications within the lower cost profiles that are required for the next series of EOS missions. NASA intends to obtain ideas from the science and applications communities for post-2002 mission concepts, and then to build with their help a nominal multi-mission profile for Earth observation satellite missions in the 2003-2010 time frame. The purposes of the multi-mission profile are:

〈 To guide science and application research investments in preparation of the missions;

〈 To guide ESE technology investment in preparation of the missions; and

〈 To constitute the basis for discussion with potential commercial and international partners having missions in that time frame

The Earth Science Enterprise intends to periodically refresh this nominal mission profile through similar consultations with the Earth system science and applications communities.

In developing its measurement strategy, the Earth Science Enterprise desires to reduce the risk to overall program objectives from any single mission failure by developing smaller, less expensive missions and implementing shorter development cycles from mission definition to launch. Shorter development times will allow more flexible responses to current and evolving scientific priorities and more effective uses of the latest technologies. In accordance with this philosophy, the implementation of each successive future mission in the ESE flight program will be based on a specific Announcement of Opportunity (AO) and competitive selection of instrument payloads and implementation options. It is important, under this new approach, that instrument technology developments be conducted largely before the relevant mission payload selection. A science and applications-based flight mission profile is indispensable to guide these pre-mission technology developments, particularly the Enterprise's Instrument Incubator Program (IIP). The first IIP research announcement is listed under NASA Research Announcements at:

http://www.hq.nasa.gov/office/ese/nra/index.html

The size of individual missions and the content of the multi-mission profile will be determined by balancing the science and applications requirements, the technology capabilities, costs, and risks in order to achieve a "best value" within the program. However, NASA envisions that the missions of the future will not exceed a total life cycle cost 30 to 50% of the EOS PM-1 and CHEM missions, and that most missions will be even smaller.

Smaller missions will mean more focused mission objectives, targeting specific scientific questions that are perceived to be the continuing or emerging research priorities of the next decade in Earth system science and applications. The Earth Science Enterprise will continue to support research in climate variability, land-cover and land-use change, natural hazards warning and assessment, atmospheric chemistry, atmospheric radiation and dynamics, land-surface hydrology, physical and biological oceanography, marine and terrestrial ecology, polar research, and geology as well as applications of remote sensing. The range of appropriate science content is included in the available on-line Mission to Planet Earth Science Research Plan at:

http://www.hq.nasa.gov/office/ese/ visions/index.html

and the new vision of evolving scientific research priorities may be found in Annex 1 of this announcement.

For the most effective use of the limited resources available for the ESE follow-on program, it is important that an optimal prioritization of near-term missions be achieved. The requested mission concept responses and their scientific justifications will become a part of the process leading to prioritization and identification of a more focused and economical future course for the Earth Science Enterprise.

The specific purpose of this Request for Information is to assist the Earth Science Enterprise in defining a set of focused mission objectives and developing a nominal multi-mission profile covering the next 5-7 years after the CHEMISTRY mission. The information received will be used to construct and compare alternative mission scenarios, explore implementation options, including partnering relationships, and guide technology development and infusion plans. The possibility of joint ventures with commercial satellite operators or data purchase projects involving shared NASA/industry participation will be evaluated and explored. It is the Enterprise's intention to periodically revisit the nominal multi-mission profile in cooperation with the Earth Science community in order to modify and redirect the program, as appropriate. The follow-on ESE multi-mission profile needs to be complementary to the current set of existing or planned operational, commercial and foreign satellite remote sensing systems. This profile must, in particular, take into account the expected convergence of the DOD, NOAA and NASA observation requirements through the implementation of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) for systematic long-term atmospheric, oceanic and land surface observations. A reference on the Internet for the latest POES-NPOESS Transition Study may be found at:

http://poes2.gsfc.nasa.gov/npoess.htm

Furthermore, the follow-on ESE program will continue to include the on-going Earth System Science Pathfinder (ESSP) program of small research satellite missions. The latest Announcement of Opportunity for ESSP missions may be found on the Internet at:

http://www.hq.nasa.gov/office/ese/nra/ao98oes01/index.html

The objective of this RFI is to identify high-priority Earth system science and application mission concepts that do not belong in the ESSP program for reasons of size/cost, or the need for systematic measurements over an extended period of time.

A two step planning process is envisioned to assist the Earth Science Enterprise in formulating the ESE follow-on nominal multi-mission profile.

Step 1

The objective of the first step is to assemble a collection of Earth observation mission concepts. Each individual concept should cover the following points:

1. What specific scientific question or application objective will be addressed by the mission concept and why is this considered to be essential for the progress of Earth system science and applications in the next decade, beyond the anticipated achievements of the first EOS series?

2. What new or existing observing capability or technology is proposed for this purpose, and why is this measurement approach judged to be particularly appropriate and timely for investigations to be carried out in the next decade?

3. What measurement strategy is proposed to address the scientific or applications objective(s) proposed above? Specifically, will the objectives be attained by a single research-oriented satellite mission of limited duration, a constellation of spacecraft, or a series of successive flight missions for systematic monitoring? What supporting satellite or other complementary measurements are assumed?

4. What are the technical characteristics of the mission concept (outline of instrument technology and spacecraft architecture, orbit and launch vehicle requirements, duration of the mission, and other relevant information)?

The Earth Science Enterprise would like to receive, by 8 June 1998, brief mission concept papers prepared by leading scientific investigators or remote sensing application teams, and submitted through the responding team's institution. In order to expedite logistics, it is requested that responses be about five (5) pages, and presented in a common format (based on the template provided in Annex 2). One additional illustration, chart or plot may be submitted, if necessary to clarify the concept. Only concepts judged to be highly significant should be presented, and a reasonable degree of screening is expected from the institutions submitting concept papers.

NASA does not intend to award contracts or grants on the basis of this RFI or to otherwise pay for the requested information. Mission concepts collected by this Request for Information will be reproduced in publicly available documents for preliminary evaluation by a panel of experts.

The received mission concepts will be reviewed by multi-disciplinary panels of science and application experts selected by NASA. The concepts will be ranked for significance and relevance of science or application objectives, value to NASA and the Earth science community in comparison to existing and planned remote sensing measurements, technical feasibility and development practicality, and proposed development schedule. The mission concepts selected by the reviewers will be used in the next step to build a range of alternative multi-mission profiles for the first decade of the next century.

Step 2

NASA will undertake to construct several tentative EOS follow-on multi-mission profile scenarios, incorporating various possible subsets of mission concepts assessed in Step 1. These scenarios will take into account the Earth Science Enterprise's programmatic constraints as well as existing commitments to the development of national operational environmental satellite systems and international cooperation with foreign space agencies. The suite of viable mission profile scenarios will be presented to a workshop to be convened in late August 1998, with the participation of a panel of experts selected by NASA and one representative for each of the mission concepts resulting from Step 1. The workshop will provide views to the Earth Science Enterprise concerning the flight program that best fits the Enterprise's scientific and applications objectives, expected technological capabilities and programmatic constraints for the time period of 2003-2010.

The result of this Step 2 review process will be the formulation of a nominal flight mission profile that will guide Earth Science Enterprise activities, drive technology developments and provide an initial timeline for mission implementation beyond the current series of EOS satellites.

It is understood that, in accordance with the practices adopted by the Enterprise, the actual definition and selection of the payload for each successive mission in the profile will be determined through open, competitive Announcements of Opportunity that will be released periodically, beginning in 2000 or 2001.

ANNEX 1

NEW VISION OF EARTH SCIENCE AND APPLICATIONS RESEARCH PRIORITIES

INTRODUCTION

The goals of the Earth Science Enterprise are to use the global perspective of observations from space to understand the planet as a complex, coupled system (involving the atmosphere, oceans, land and ice surfaces and the living biosphere), and to enable an improved stewardship of our environment with sustained human progress through space observations and the assessment and mitigation of the effects of natural disasters.

The program of the Enterprise will be guided by the following over-arching questions:

Is the climate changing in ways we can understand and predict?

Can we understand and predict how terrestrial and marine ecosystems are changing?

Can we understand and predict how atmospheric composition is changing?

Can we improve our understanding of the processes and dynamics of the Earth's surface and interior, and use this knowledge to assess and mitigate natural hazards?

Can NASA assist in the development, implementation, testing and evaluation of new, applications-oriented sensors that will help the public, other Agencies, State projects, or commercial interests to use the perspective and quantitative measurement capability of space-based observations for the public good?

In the post EOS AM-1, PM-1, and CHEM time period, we will have made significant advances in space observations of the Earth system, but we expect to need continuing measurements of specific components of the system as well as new measurements allowed by emerging technologies. We plan to conduct those measurements within a new NASA paradigm for space-borne projects that will emphasize small, focused missions to test hypotheses and address key questions. This new paradigm calls for a balanced program of space observations, airborne and ground-based measurements and modeling. Such a program will conceptually link and coordinate all aspects of the Earth Science Enterprise.

FIVE QUESTIONS AND THEIR IMPLICATIONS FOR FUTURE SPACE OBSERVATIONS

1. Is the climate changing in ways we can understand and predict?

Climate is continually changing from one season to the next, one year to the next, one decade to the next. The real question is not whether we can measure climate change, but whether the changes we do observe correspond to mechanisms or processes we can understand, predict and, in general, attribute to a specific cause. Another aspect of the same problem is determining the effect changes in global climate may have on the frequency and intensity of severe weather events and the impact of transient climate variations, such as El Niño phenomena, on different regions of the world.

Climate is the integrated result of weather. Because these phenomena are manifestations of extremely complex interplay between a multiplicity of non-linear processes, there is no way we can unravel causes and effects on the basis of one or a small set of characteristic measurements - such as a record of global mean atmospheric temperature. We strive instead to acquire as complete a description of the atmosphere-ocean-land system as possible, leaving no loose end that allows alternative explanations and residual uncertainty. We depend heavily for this purpose on systematic observation and analysis carried out by operational environmental agencies for weather and climate forecasting purposes. Accordingly, the Office of Earth Science attributes high scientific value to the improvement of global operational environmental observing and data analysis systems, for example the National Polar Orbiting Environmental Satellite System (NPOESS), which will begin operations in the early part of the 21st century.

Many external factors that govern the earth climate - such as radiation received from the sun, aerosols from natural or anthropogenic origin, the concentration of greenhouse gases - or slowly evolving components of the earth climate system, especially the world ocean circulation, global terrestrial vegetation, snow/water storage on land, the mass balance of the Greenland and Antarctic ice-sheets, cannot be adequately determined from existing operational observations. An essential objective of the Office of Earth Science is to develop new observing techniques for measuring these factors or components from space and, in cooperation with partner agencies, define an international observing strategy to systematically sample relevant global properties.

A third, equally essential task is investigating the processes that play an important role in defining the earth climate. Foremost among these is the complex interplay of water vapor, liquid and ice with atmospheric radiation transfer. The accumulation of snow, the storage of water and subsequent evaporation of soil moisture control climate over large continental areas. Deep-water formation, the sinking of cold saline water in the North Atlantic Ocean, controls the transport of heat to high northern latitudes without which the climate of Europe would be similar to that of Alaska. The formation, transport and melting of sea-ice govern the energy budget of Polar Regions, heat transfer from the ocean to the atmosphere and the fresh water balance of the oceans, thus affecting global climate. The mechanics of glaciers and ice sheets determine the mass balance of land ice, future changes in the volume of the oceans and global mean sea level.

In addressing the above over-arching climate question, the Earth Science Enterprise will obtain data on climate diagnostics, forcings, and impacts. These data will be used to address the following crucial questions:

-Are global and regional-mean surface temperatures rising or falling?

-Will the frequency and intensity of the El Niño phenomena and of severe weather events change in response to environmental changes and can we achieve a better capability to predict them?

-Can we link changes in water vapor, cloud properties and the hydrological cycle to changes in the circulation of the global atmosphere?

-Do we understand the linkages between climatic changes, ocean circulation and ice sheets?

-Will an increase in atmospheric aerosols offset the heating caused by greenhouse gases?

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2. Can we understand and predict how terrestrial and marine ecosystems are changing?

Terrestrial and marine ecosystems undergo changes that are the results of human activity, of their own intrinsic biological dynamics, and of climate variability and change. There are very few landscapes on Earth that have not been significantly altered or are not being altered by humans. Since nearly half the global population resides in coastal regions, the coastal biosphere is increasingly impacted through anthropogenic activities, both intentional and accidental. As the human population of the Earth continues to grow, there will be continuing pressure on the Earth's biological resources to provide food, fiber, and maintain ecosystem services in a sustainable, long-term fashion. As in the case of the climate, the challenge is to detect the changes and to sort out the contributing factors. Ecosystems also act as mediators of feedbacks to atmospheric chemistry and climate, both in terms of alterations of water and energy budgets and in terms of fluxes of greenhouse gases. Determining the sign and magnitude of the feedbacks is essential to assessing the interaction of biogeochemistry on atmospheric gas composition and its radiative forcing.

The effort to understand the observed changes in terrestrial and marine ecosystems, and to predict their capacity to sustain biological productivity and diversity requires a coordinated Earth system science program in which terrestrial, atmospheric and oceanic processes are examined, modeled, and monitored.

There are three broad objectives associated with such a coordinated program. The first is to document the current patterns of land-cover, terrestrial and ocean productivity, and their changes on interannual time scales. The current pattern of land-cover most often reflects past and present land-use. The larger patterns of land-cover are observable and can be monitored from space. From historical archives, including the last twenty years of satellite data, one can build a quantitative assessment of landscape and land-use change, and associated changes in terrestrial productivity and processes. Subtler types of change which take place, for example, through intensification of human use, require additional in-situ information. The ability to document the spatial patterns of ocean productivity is relatively recent, and the ability to detect changes quantitatively is evolving rapidly, as new sensors such as SeaWiFS provide data. We must, therefore, improve and maintain the capability to perform repeated global inventories of land-cover and land-use and ocean productivity patterns from space, and to develop the scientific understanding and models necessary to evaluate the consequences of the observed changes.

The second major objective is to understand the processes that control patterns and changes in marine and terrestrial ecosystems. In both marine and terrestrial ecosystems, factors affecting primary production ultimately affect the abundance and diversity of life within the whole ecosystem. Using space-based measurements, we are able to observe and document changes in primary production. Primary productivity, or the process of photosynthetic carbon fixation, is a major sink for atmospheric CO_2, whereas respiration and organic decay subsequently release carbon back into the atmosphere. Total fluxes due to these processes are on the order of 150-200 GtC/yr, but it is the net fluxes that we seek to understand. Contributions of the biosphere to net changes in atmospheric CO_2 are the most important carbon-related phenomenon to understand from a climatic perspective. These net fluxes, on the order of 1.5 to 2.0 GtC/yr, reflect a non-equilibrium state in the global carbon cycle. The role of the biosphere is complex. Carbon is being transferred from tropical ecosystems and sequestered in northern boreal ecosystems, and yet the specific location and processes involved in this sequestration are unknown. Furthermore there are important interannual variations in biologically mediated carbon fluxes that are poorly understood. It is critically important to understand the processes by which these fluxes are mediated, and the interactions with nitrogen fluxes, atmospheric CO_2 concentrations, soil condition, climate variability, and human activities. As the US government evaluates its policy options for responding to the Kyoto protocols, understanding these issues takes on a new level of international policy importance. Space observations and tracking of these processes as they are represented in surface reflectance, microwave backscatter, and in the distribution of biomass are very high in priority both for understanding terrestrial and marine ecosystems, and their impact on climate.

The third major objective is to develop predictive capabilities for ecosystem processes and patterns, both in terrestrial and marine environments. In both environments, the Earth Science Enterprise is already carrying out major model development and intercomparison programs that utilize remote sensing data. Current data are used either to derive critical model parameters, as for example in the use of NDVI data to derive the fraction of absorbed photosynthetically active radiation; or independently to validate model results, as in the use of phenological information derived from AVHRR data to query the reliability of ecosystem models in reproducing accurate seasonal cycles of primary productivity. As the observational base becomes richer, more complete, and better calibrated, the ability of the modeling community to explore the use of remotely sensed data will additionally grow.

To address the issues associated with the above over-arching question for terrestrial and marine ecosystems, the Earth Science Enterprise will therefore acquire data on the distribution and changes in terrestrial and ocean conditions and productivity, the processes that control or are altered by these changes, and will develop and validate predictive models to address the following critical questions:

-What are the magnitude and variability in net emissions from changes in tropical land-use?

-What are the magnitude and variability in terrestrial biological productivity, and what processes control it?

-Can we predict the ability of terrestrial and marine ecosystems to continue to provide food, fiber, and ecosystem services in the face of growing human populations and climate variability and change?

-What controls primary productivity in major ocean ecosystems on interannual and decadal time-scales, and thus the ability to predict how these ecosystems will respond to and influence climate change?

-How long can the biologically-mediated sinks of carbon continue to operate before other limiting factors come into play?

-What are the current fluxes of radiatively important trace gases from terrestrial and marine ecosystems, and how might they change?

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3. Can we understand and predict how atmospheric composition is changing?

In the last two decades an integrated program of space, aircraft, balloon, and ground-based measurements has established that the chemical composition of the atmosphere is changing and that some of the changes, such as the buildup of chlorofluorocarbons and of carbon dioxide are the result of human activities. In the case of chlorofluorocarbons (CFCs) buildup, it has been further established that these long-lived compounds are lifted into the stratosphere, broken down by solar ultraviolet radiation, and become the sources of highly reactive chlorine atoms, which catalytically depletes the earth's protective layer of stratospheric ozone.

In response to these findings, the nations of the world have placed limits on the emissions of CFCs that are now beginning to decrease in the lower atmosphere. Within the next decade they will decrease in the stratosphere, which will result in less depletion of stratospheric ozone. A major challenge of atmospheric chemical research in the coming decade is to follow this process and to ensure that no unexpected problems with stratospheric ozone arise from the CFC substitutes and growing use of other halogen compounds or from climate changes that could affect stratospheric chemistry.

Buildup of stable, long-lived gases such as carbon dioxide, methane, and nitrous oxide underlies the "greenhouse gas" phenomenon and is a forcing factor in radiation balance. More reactive gases, such as carbon monoxide and ozone, also play an important role in this phenomenon. Understanding the chemistry of these gases, most of which occurs in the troposphere is another major focus of global atmospheric chemistry research.

Apart from the role of these reactive gases in global radiation balance, there is another important issue surrounding them. As the developing and emerging nations, particularly in Asia and Latin America grow in population and economic activity, emissions of pollutant gases, such as CO and the oxides of nitrogen that largely control tropospheric ozone concentration, will undoubtedly increase enormously. The effects of this growing atmospheric pollution on a global scale are not well predicted because natural processes that both emit gases into the atmosphere and remove human pollutants through photochemistry are not well characterized. Understanding and predicting these effects is a frontier area of atmospheric research for the next decade and beyond. It is a global scale problem that lends itself particularly well to the use of space observations and correlative and complementary in-situ measurements

Given the current status of knowledge of stratospheric and tropospheric chemistry and expected scientific return from current and planned space measurements (UARS, TOMS, SAGE, and the instruments on the planned CHEM satellite), a series of measurements with smaller instruments that will incorporate advanced technology can be identified for the post CHEM era with the new NASA paradigm of smaller, focused missions.

For stratospheric chemistry global measurements of total ozone and ozone vertical distributions will be the principal long-term requirement as the ozone layer recovers in response to the Montreal Protocol limitations on CFCs. To track cause and effect, measurements will be needed of several key chemical species that are involved in the chemistry of ozone depletion or that are chemical tracers of atmospheric transport. Measurements of aerosol content of the stratosphere will define volcanic influences on stratospheric chemistry. Direct measurements of source gases such as CFCs, hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) will also be a long term need.

For tropospheric chemistry global scale measurements of ozone as a function of altitude are key requirements from both a climate impact and a global pollution perspective. The ozone concentration levels in the troposphere are controlled to a large extent by concentrations of oxides of nitrogen, which originate mostly in the lower troposphere. Long term measurements of the oxides of nitrogen will be needed to track cause and effect relationships between tropospheric ozone and pollution growth. Measurements of carbon monoxide concentrations as a function of altitude and geographic location will be valuable as a pollution indicator and a tracer for tropical overturning. Natural fluxes of key tropospheric chemicals into the atmosphere from both land and water will be a key input to global chemical models. It will also be important to determine the extent to which changing atmospheric aerosol concentrations will modify tropospheric chemistry.

The studies undertaken to answer the above general question will provide answers to three important questions that are certain to be at the center of public environmental concerns in the first decade of the next century:

-Is the Montreal Protocol working as expected to stop ozone depletion in the stratosphere by manmade chemicals, and is there any threat that is not yet recognized which will require additional government action?

-How can space observations contribute to better detection and characterization of regional to super-regional air pollution and assist in dealing with control issues that transcend state and even national borders?

-To what extent is industrial and urban pollution distributed globally and what will be the global atmospheric consequences of large-scale pollution as emerging economies greatly increase their use of fossil fuels?

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4. Can we improve our understanding of the processes and dynamics of the Earth's surface and interior, and use this knowledge to assess and mitigate natural hazards?

The Earth is a dynamic planet that is constantly changing, not only at its surface but within its interior as well. From direct and often catastrophic experience, we know that internal motions of the Earth crust can generate earthquakes and melting of rocks in the lithosphere is the origin of volcanism. The flow of the planetary core generates the Earth's magnetic field, which ultimately protects life on the planet from the harmful effect of energetic particles from the sun.

We already have considerable knowledge of the structure of the Earth interior, the metallic core, the mantle of dense minerals, and the lighter lithosphere and crust. Each of these components is in motion, although at greatly different velocities. Movements in the core generate the magnetic field; changes in the flow of the core result in sudden changes in the polarity of the Earth's magnetic field. The mantle drives the lithospheric plates causing them to collide, subduct in to the mantle and melt, thus separating the lighter minerals that feed volcanoes. At the Earth's surface, anomalous weather and climate events, especially unusual rainfall, interact with the solid Earth and drive the landscape toward a new equilibrium, often through catastrophic landslides, flooding and beach erosion.

In order to understand these phenomena and interactions, scientific questions such as the following need to be addressed:

-Can we understand the forces that drive earth motions from the core to the surface?

-Can we determine the fundamental processes controlling earthquake generation?

-What are the processes by which landscapes are formed and modified?

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5. Can NASA assist in the development, implementation, testing, and evaluation of new, applications-oriented sensors that will help the public, other Agencies, State projects, or commercial interests to use the perspective and quantitative measurement capability of space-based observations for the public good?

NASA's Applications and Outreach Program is very diverse in its scope and impacts. Some examples of its current capabilities range from assisting today's measurement-oriented precision agriculture to improve crop yield to developing tools that can interpret operational satellite and direct broadcast data in forms that help in real-time disaster loss prevention and mitigation efforts.

Observing the surface extent of flooding and the threats to life and property are paramount in national and state agency efforts to help people. Certain businesses can benefit by more precise mapping and automated integration of land/civilization features observable through high-resolution remote sensing.

NASA has an enabling role in helping people to gain greater benefits through the intelligent use of precise remote sensing from satellites and other platforms.

In certain cases, NASA might develop a new sensing technique or improved sensor for airborne testing and eventual use on a satellite of opportunity. In others, NASA might develop new computer techniques using advanced technology and possibly even on-board processing to save communications bandwidth and make real-time warnings from satellites a reality. In still other situations, NASA might team with industry to develop and test new methodologies that eventually might become an asset to commercial remote sensing.

The potential for new space observation-based applications is limitless, and many techniques already have been tested and proven successful. In responding to the challenge for development of new sensors in this area, one should consider the ultimate value to people as having high merit. Thus, a sensor/system for the detection of, say, fires from space would be beneficial in terms of preventing the loss of lives, property, and environmental resources or diversity. A system which could integrate satellite-derived rainfall, flooding potential, reservoir content, and model runoff in the traditional hydrological sense could help the many agencies concerned with water as a resource or as a threat.

There are many types of surface and/or vegetation mapping applications that would assist the responsible agencies in their missions of enabling sustainable development. Applications have new frontiers, as well. For instance, there is new hope in tracking the expansion of disease-generating environments, such as mosquito habitats, so that early warning of potential epidemics might be possible.

The concepts for new applications should not be limited to these alone. The purpose of this brief listing is to suggest that the scope of potential applications is large and the ways that remote sensing data from satellites might be used has just begun to be defined. There may be opportunities for additional commercial involvement, interagency demonstration projects, direct-to-the-public transmissions from satellites, and monitoring of new, life-saving data from space.

NASA is open to the consideration of all forms of new and improved applications of satellite remote sensing data.

Today's NASA has placed a greater emphasis on public outreach and specifically is expanding a programmatic effort in that direction; hence it would also seem appropriate to consider the potential uses of satellites in the role of enabling greater public outreach. This could take the form of transmissions of data products processed on-board a spacecraft directly to the public or, perhaps, the concepts surrounding the "data base in the sky" of using satellites to generate, accumulate, and retransmit requested environmental information to the public. This area has the potential for wide distribution of remotely sensed information when considered in conjunction with the expected expansion of Internet and communication capabilities that will be available to the public.

ANNEX 2

TEMPLATE FOR MISSION CONCEPT PROPOSALS

1. Scientific or Applications Rationale

Describe in adequate detail the broad scientific or application objectives of the mission and the specific results expected from the proposed measurement(s). Explain the unique significance of the expected results, in the broad context of Earth System Science and Applications for the next decade. Describe in what way the outcome of the proposed mission would add to the results that will be achieved with the first EOS satellite series and contemporaneous satellite missions worldwide.

2. Measurement Approach and Specific Objectives

Describe unambiguously the unique objectives of the measurement approach in a way suitable to guide further technology developments (in particular the development of the Enterprise's Instrument Incubator Program) and to structure a future Announcement of Opportunity for the implementation of the mission(s). Include specific metrics of mission achievement performance to illustrate the value for particular science or applications disciplines.

3. Mission Type

Indicate the nature of the mission concept:

· Single research satellite project: Explain the extent to which the proposed science or application objectives can be met by a single, one-of-a-kind mission of a specified limited duration.

· Multiple research satellite project: Justify the need for a constellation of spacecraft or formation flying of multiple platforms. Specify the mission duration required to meet the objectives of the mission.

· Measurement technology demonstration mission: Explain what potential future measurement capabilities or operational applications might emerge as a consequence of this technology demonstration.

· Systematic measurement program, aiming to continue an existing measurement series or initiate a new type or higher performance type of environmental measurements. Indicate over what period of time the measurement needs to be maintained in order to achieve the proposed objectives.

4. Remote Sensing Measurement Techniques

Indicate the specific measurement principle(s) involved in the mission concept, general characteristics and unique expected performance of the intended measurement technique(s). Provide relevant background information concerning the degree of maturity/availability of these techniques. Explain in what way the suggested implementation options constitute an advance beyond the performances achieved by the first EOS satellite series and contemporaneous satellite missions worldwide. Identify the technological difficulties that will need to be mastered in order to implement the project as intended, and suggest potential improvements that could be achieved with further technological progress.

5. Technical Characteristics

Provide any readily available information, such as estimates of relevant spacecraft characteristics, payload requirements, orbit requirements and other information that may help NASA in assessing the size and cost of each mission concept.

SCHEDULE

Deadline for Submission of Post 2002 Era EOS Mission Concepts	8 June 1998
Panel Review	Middle of June
Workshop to Form Nominal Mission Profile	End of August
Results Available for Program Formulation	Early September

Responses may be sent via electronic mail to:

oesresponse@hq.nasa.gov

or by mail to:

(Please provide an electronic copy in Microsoft Word format in addition to the printed version of each mission concept.)

Post-2002 Mission Concepts
Code Y
400 Virginia Avenue, S.W.
Suite 700
Washington, DC 20024

or by Fax to:

Post-2002 Mission Concepts
Attention: Ms. Dawn Cardascia
(202) 554-2970

Point of Contact at NASA:

Dr. James C. Dodge
Earth Science Enterprise
NASA Headquarters
Tel. (202) 358-0763
Fax (202) 358-2770
E-mail: jdodge@hq.nasa.gov